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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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10/660,561

09/12/2003

Jeong-Wook Lee

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11/15/2005

BUCHANAN INGERSOLL PC  
(INCLUDING BURNS, DOANE, SWECKER & MATHIS)  
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EXAMINER

MULPURI, SAVITRI

ART UNIT

PAPER NUMBER

2812

DATE MAILED: 11/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

|                              |                        |                     |  |
|------------------------------|------------------------|---------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                              | 10/660,561             | LEE ET AL.          |  |
|                              | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                              | Savitri Mulpuri        | 2812                |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 04 November 2005.
- 2a) ☒ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/04/2005 has been entered.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al (2003/0010971 A) In combination with Tsakalakos et al (US 20040077156)

Zhang et al teaches a method of manufacturing a device by the following process steps:

Sequentially stacking a first semiconductor layer "82", a mask layer "96" and a metal layer "84" on a substrate (see fig. 5B);

anodizing the metal layer to transform metal layer into a metal oxide layer "86" including a plurality of nanoholes "88" (see fig. 5C)

etching the mask layer using the metal oxide layer as an etch mask until the nanoholes "98" are extended to the surface of the first semiconductor layer (see fig.5D);

removing the metal oxide layer by etching; and depositing a second semiconductor layer "90a,90b,92 within the nanoholes and on the mask "96" (see fig. 5D- 5F and para. 0041). Zhang et al indirectly teach filling the quantum dots "90 a, 90 b" to either completely or partially fill the nanoholes by disclosing, in some embodiments, quantum dots 90 a, 90 b are grown to completely fill nanoholes (see para0041). When quantum dots are partially filled in the nanoholes semiconductor layer "92" is grown in the nanoholes and on the top of the mask "96, which supports amended limitation in step "f"

In re. to cl. 2, the diameter of the naanoholes is 10 to 100 nm (para. 0038, lines 1-8).

In re. to cl. 3, Zhang et al the area of the holes are inherently less than 50 percent of the whole area by showing metal oxide "86" wider than nanoholes "88" (see the fig. 5 C)

In re cl. 4 mask thicknesses must inherently same as claimed thickness., because both Zhang et al and instant invention has same goal of forming nanoholes with same diameter.

In re. to cl.5, Zhang et al uses a substrate made of GaAs and semiconductor layer made of AlGaAs and both GaAs and AlGaAs have different lattice constants.

In re. to cl. 6 the substrate is GaAs(see fig.5A)

In re. to cl.9 , cl. 11 the mask is dielectric layer of silicon oxide “96”

In re. to cl. 12-14 Zhang further use refractory metal such titanium along with aluminum as metal layer, wherein titanium along with aluminum for good adhesion(see page 4, para. 0029).

In re. to cl. 15 etching is ion etching, which is dry etching (see para 0028, last 6 lines).

In re cl. 16 electrical charge storing material material of semiconductor “90a ,90b) is deposited in nanoholes.

With respect to claims 7 and 8, Zhang et al do not teach growing GaN based compound semiconductor layer in the nanoholes. With respect to claim 9, 10, Zhang et al do not teach polycrystalline semiconductor layer is polysilicon or polycrystalline silicon.

Tsakalakos et al teaches growing GaN based compound semiconductor layer in the nanoholes. Tsakalakos et al also teaches forming nanoholes in the mask of dielectric material “302” (see fig. 4) or mask formed from first semiconductor layer of GaN based material “102” called as defective buffer layer (see fig. 5). Growing a second GaN layer in the mask formed from first semiconductor of GaN layer “102”, wherein the second GaN layer is grown until the GaN defective buffer mask is fully covered.

It would have been obvious to one of ordinary skill in the art to grow GaN based semiconductor materials in the invention of Zhang et al because compared to GaAs, GaN has large band gap material and so can withstand high temperature and withstand high voltages during performance, it has higher peak carrier velocity, versatile for making several types of devices and good for high frequency operations. It also would have been obvious to use semiconductor material as a mask in the invention of Zhang et al because Tsakalakos et al teaches using either dielectric material or GaN material as a recognized equivalent materials to use as nanohole masks to grow nanohole GaN materials within and above the nanohole mask.

### ***Response to Arguments***

Applicant's arguments filed on 11/4/2005 have been fully considered but they are not persuasive. Applicant argues that Zhang et al teaches vertical stack of quantum dots "90,90b" comprises vertical nano-scale electronic device, where as present invention is directed to a method of manufacturing a semiconductor device wherein the semiconductor layer is present in the mask layer until the mask layer is covered by the second semiconductor layer. However, such limitation is met by the semiconductor layer "92", along with quantum dots, which is grown in the nanoholes and on the top of the mask "96".

Applicant argues that Tsakalakos et al teaches growing GaN based semiconductor layer in nanoholes and there would be no motivation to completely abandon the purpose of the Zhang et al of producing a vertical nanoscale electronic

device with GaN. However, Applicant must realize that the invention of Tsakalakos et al is to teach optoelectronic semiconductor device including quantum well laser devices with in the nanoholes of oxide or GaN (see para 0051), which is same field of endeavor as disclosed in zhang et al.

Tsakalakos et al is relied on only to the teaching of growing compound semiconductor layer such as GaN in the order of nanoscale range with in the mask of GaN until the mask is covered by the semiconductor material.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Savitri Mulpuri whose telephone number is 571-272-1677. The examiner can normally be reached on Mon-Fri from 8 a.m to 4.30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt, can be reached on 571-272-1783. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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A handwritten signature in black ink, appearing to read 'S. Mulpuri', with a stylized, cursive script.

Savitri Mulpuri  
Primary Examiner  
Art Unit 2812